Menlo Park Notebook #47 [N-79-03-20]

The dated entries in this book begin on page 165 and cover the period March-April 1879. However, the book was probably begun in December 1878. Most of the entries are by Francis Upton. There are also entries by Edison, Charles Batchelor, and Francis Jehl. Included are notes, drawings, and tests of lamps; notes, drawings, and calculations about generators; notes and calculations about meters and electric power distribution; notes and drawings of dynamometers; drawings of the telephone; and notes, drawings, and calculations about electrolysis. There are also notes by Edison on a law of "Proportion of Resistance." The book contains 282 numbered pages.

Blank pages not filmed: 54-55.

Missing page numbers: 123-134, 235-238, 243-246.

1047

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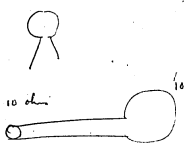
N.Y.C.,

May 1, 189 .

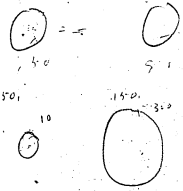


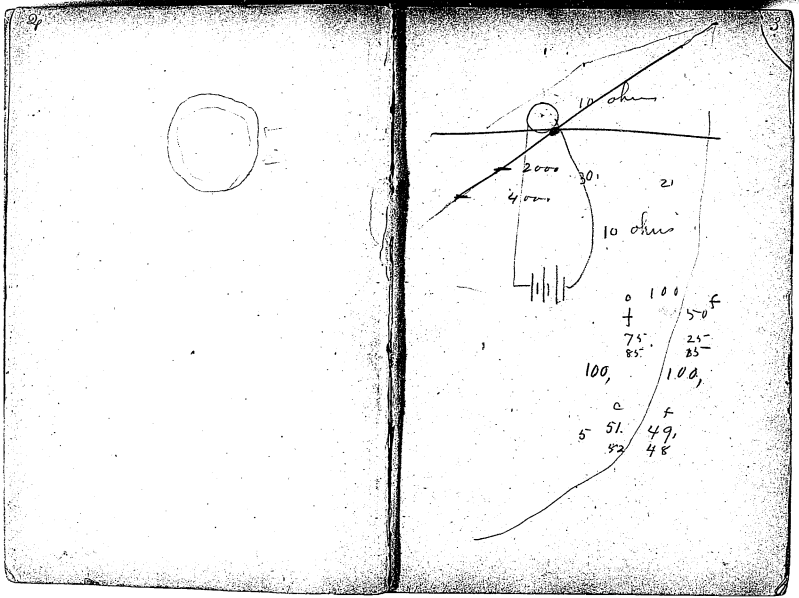
10000
3000
2 kp
4

Magnetic Switch. 1.

5-0.

4-0.




10 ohms
2000
4000
30
21
10 ohms
0
100
f
75
85
25
85
100,
100,
c
f
5
51.
49,
43
48

4

1000 20 Emf orientation

Siemens,
per hp:
10 in 10 out. 8. $\frac{1}{10}$.

2000 20

Siemens,
5 in 10 out. 10 $\frac{2}{10}$.

1000.
Perfect 20
10 in 10 out, 10.

2000
5 in 10 out 15

Proportion of Rise time 20-Emf

4. 1 hp 1000
Walker per hp 2 $\frac{1}{2}$ useful
4 1 hp 10 in 10 out,

Walker 2000
15 out
5 in. 2 $\frac{1}{7}$ useful

Grame;

1 hp 1000
10 in 10 out, —— ~~2~~ useful

4. 1 hp 2000
5 in 15 out 5 useful
4000 20

Doubling speeds,
4000,
Siemens

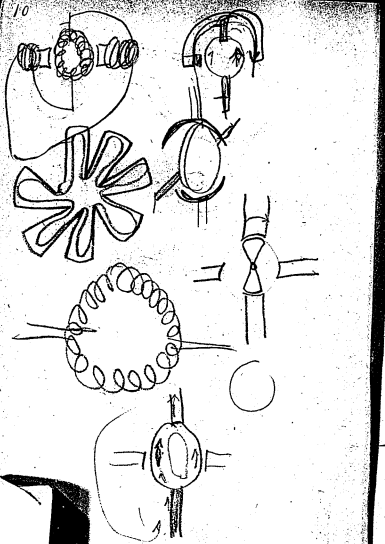
Proportion of resistance
on a machine; where the
~~fact~~ loss of ~~Com~~ power
is 1/2 in Current & 1/2 in
friction; ~~this~~ or other factor
~~Quadruples the power given~~
~~a gain~~ with a Constant
power we do not gain
anything by making the
resistance of the machine
1/4 of the External but in
a machine where the friction
or other factors absorbs less
power than the Current there
is a gain up to a certain
point, when loss commences
in a perfect machine there's gain
~~gain in perfect~~ machine. Without limit
but in a machine that

Proportion of resistance

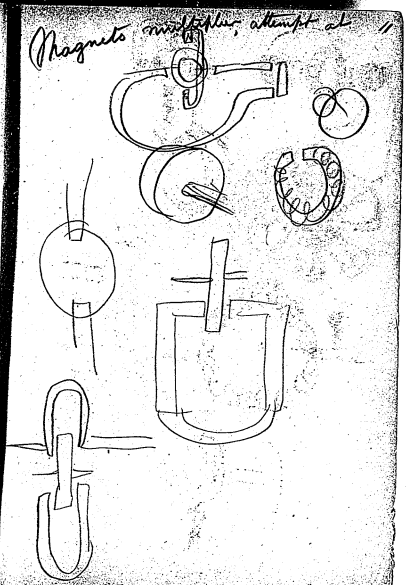
absorb more power in friction etc than the current there is a loss by making the external 3/4 & internal 1/4 -

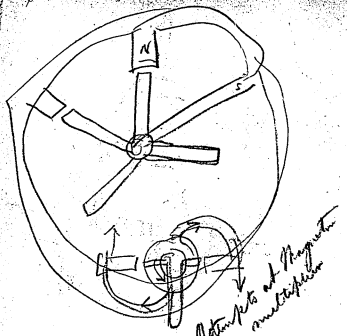
2nd Law

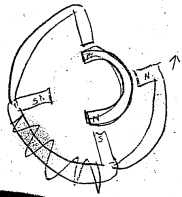
In any machine, or no matter how much power is lost by friction etc, Quadrupling the h.p. gives a gain in current, per h.p. for the reason that doubling the speed in the case of friction on doubles it while the current is quadrupled — This takes for granted that the commutator can take off the current as well at high as at low speeds



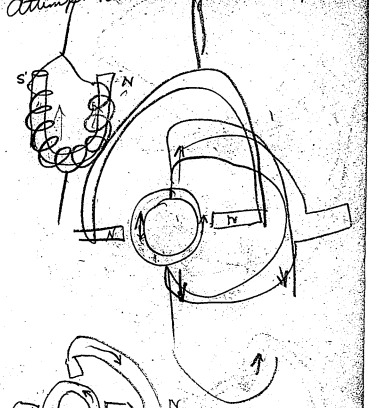
Magneto multiplier attempt at 11

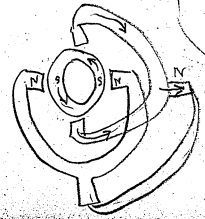




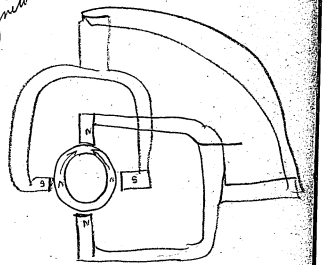


Attempt at Magnetomultiplier.





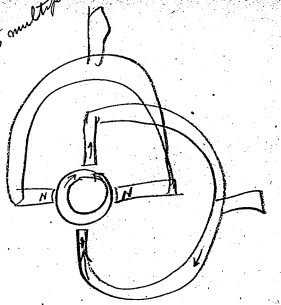
Attempt at Magneto multiplier



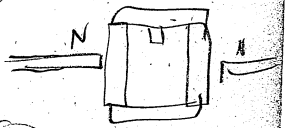
16

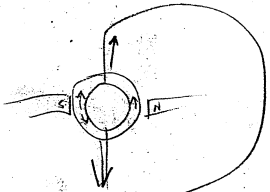
17

Magneto multiplier

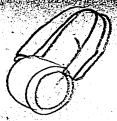


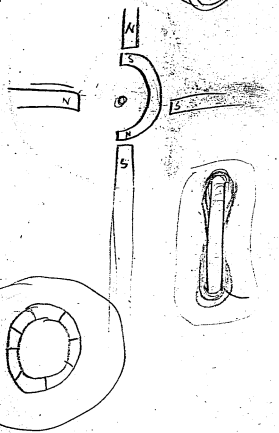
Portland





Magneto multiplier. attempt at.





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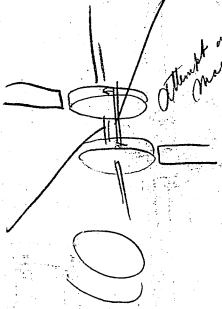

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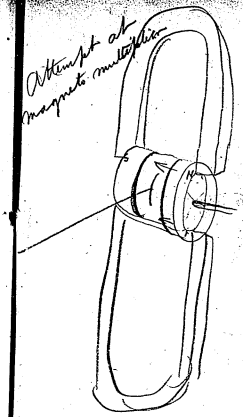
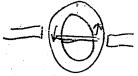
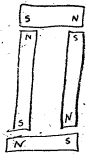
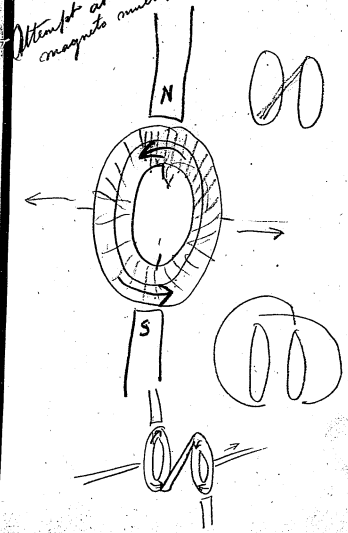
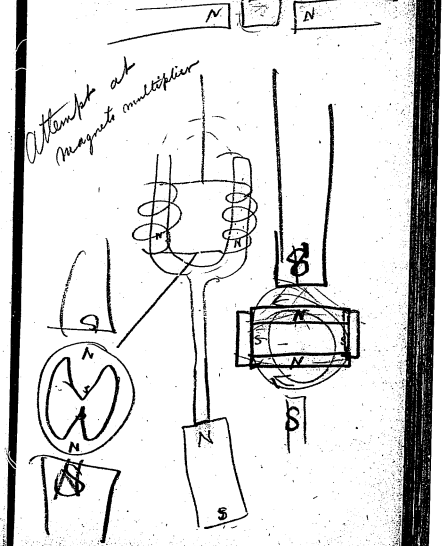


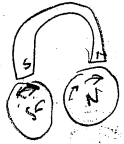




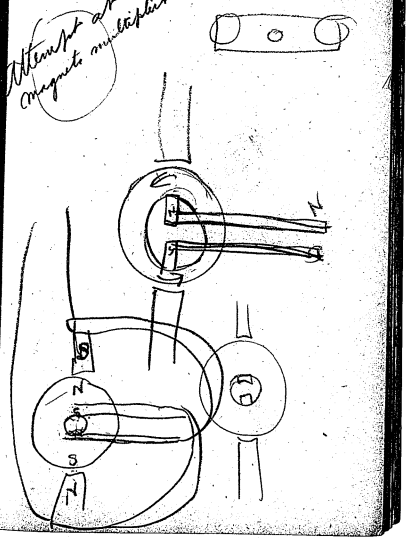
Attempt at magneto multiplier




N
N
Attempt at magnetic multiplier
N
N
N
S
N
S
N
N
S
N
S



Attempt at magnetic multiplier



$\bar{2}.0287$
$\bar{1}.7056$
$\bar{3}.7343$

$\bar{3}.4029$
$\bar{1}.0504$
$\bar{4}.4533$

$\bar{3}.3464$
$\bar{1}.4689$
$\bar{3}.0153$

$\bar{3}.7343$
1.0969
2.8312

$\bar{4}.4533$
1.0414
$\bar{3}.4947$

1.0511

$\frac{5.11}{414}$
97

$\frac{116}{65}$
$5-1$

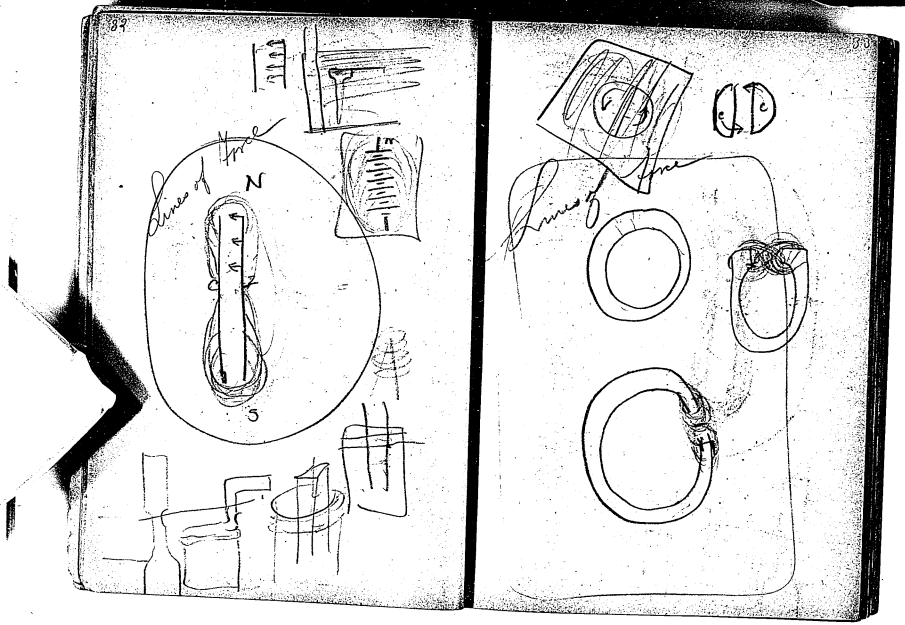
2.5711
2.6022
2.4500

372.
400.
280

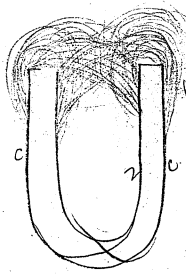
~~1437~~

0,5624

Lines of Force


N
S

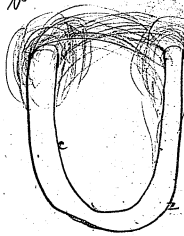
little weaker across than according to declared point

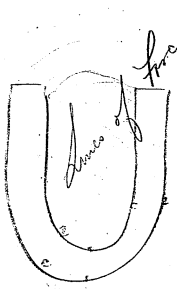


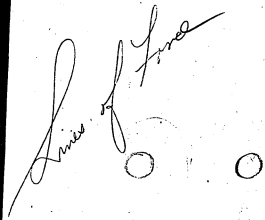
Line of force

This

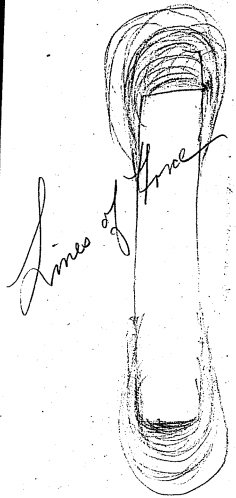
Line of force



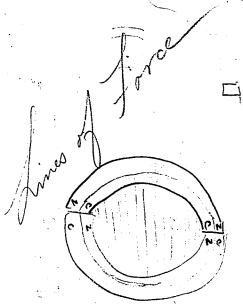

Lines of Force

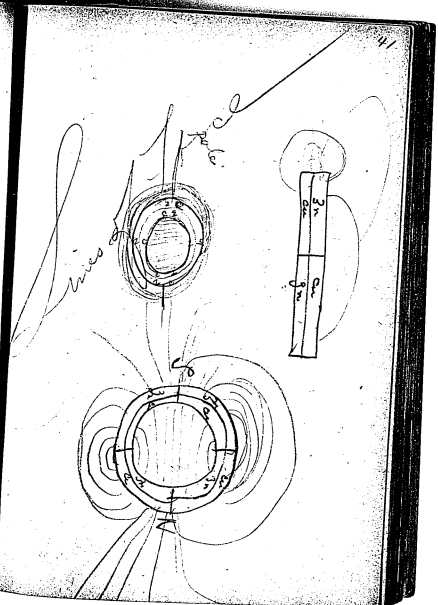

Lines of Force

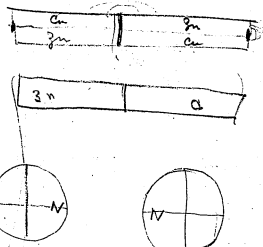
Lines of force



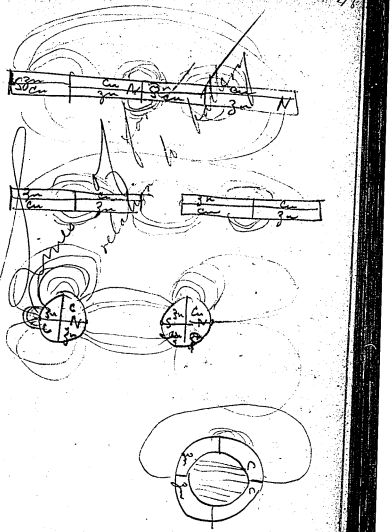
Lines of force

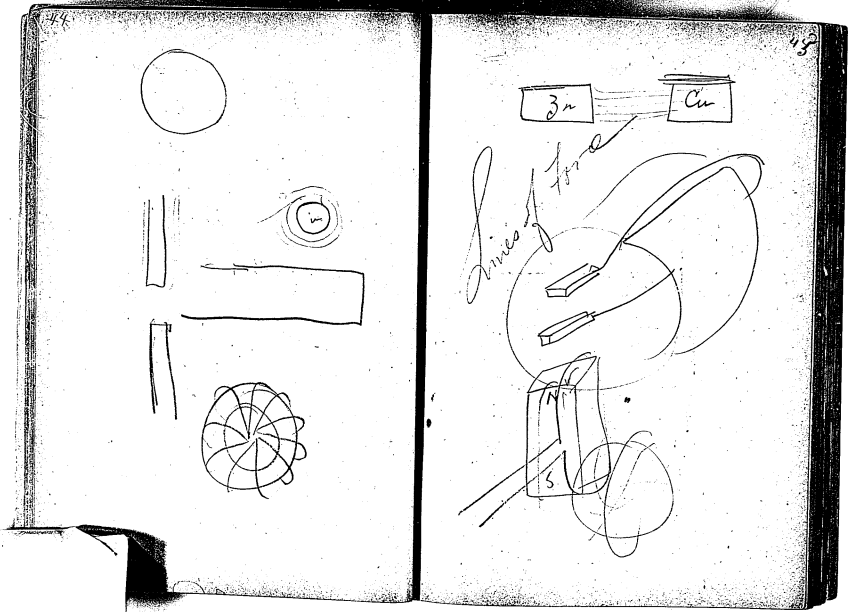

lines of force


lines of force

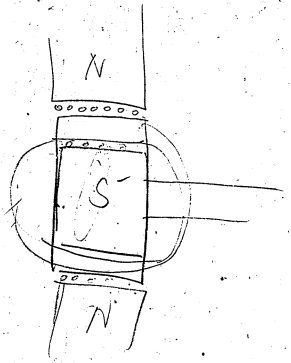


Trying to establish a relation between the magnet and Zn Cu with currents flowing in a fluid




Zn
Cu
N
S

Nitrogen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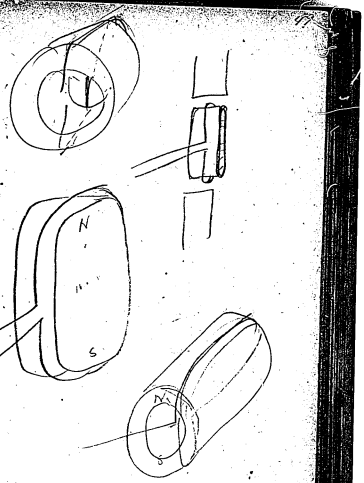
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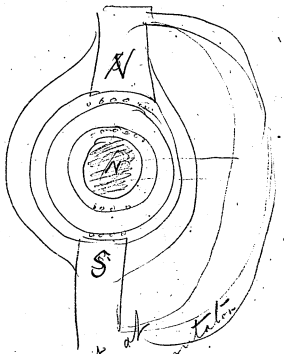
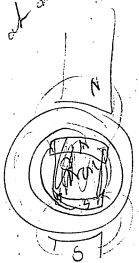
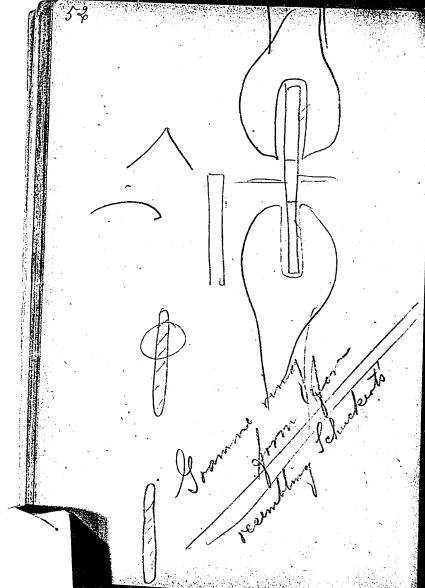
S
N
S

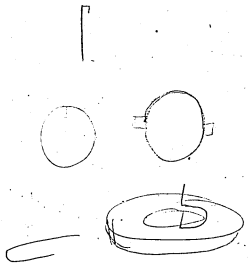


Attempt at non communication

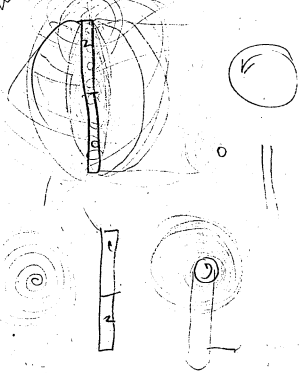
Attempt at galvanic communication







Lines of Force

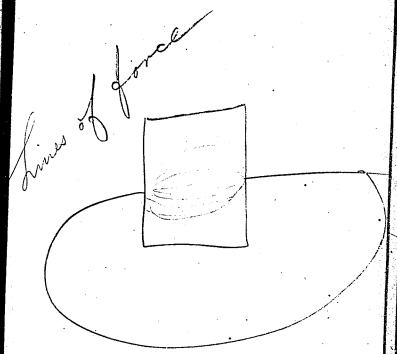


Plant 12.800.

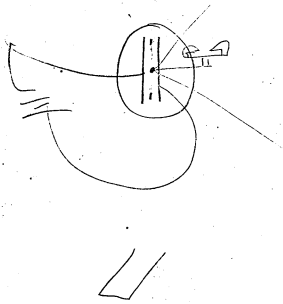
Running Expenses
Interest — 1800
Coal 1000
Engineman 1500
Cleaning 800
Incidental 1000
Depreciation 6100
3700

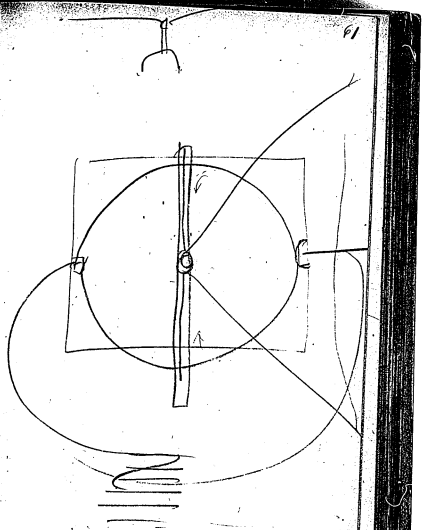
3600
1500
400
500 6100
200
2 10.00.
500
600
500 160
6
960
1280
1800
Int 1050
1500
Coal 850
950
300
350
12.75.

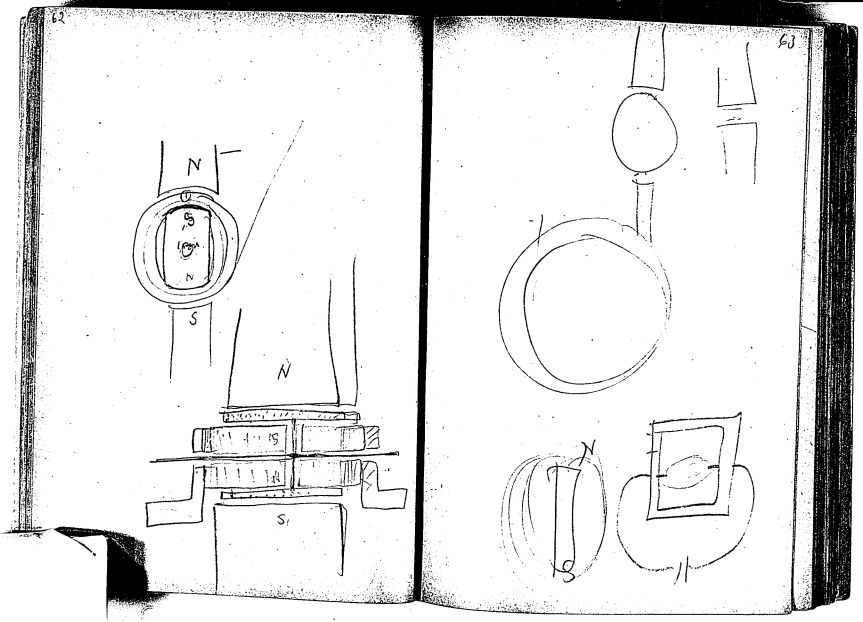
480 | 6100 | 12
480
1300
960
340



2000.



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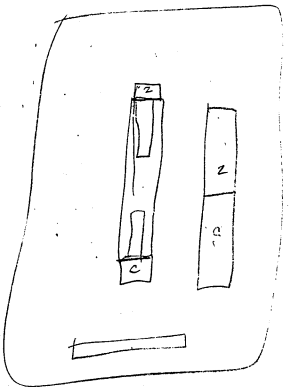
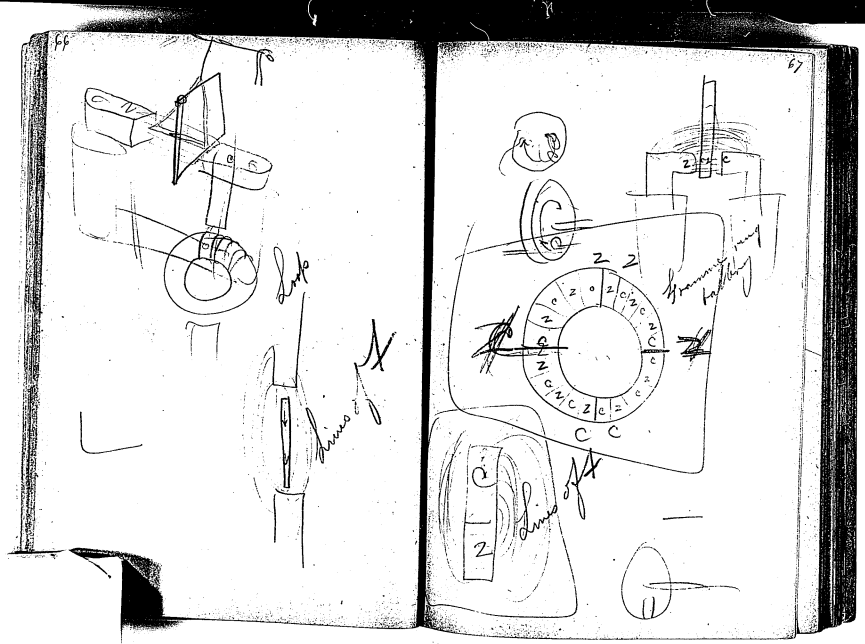
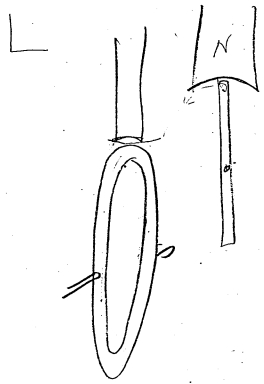
64

65



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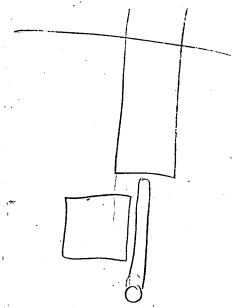
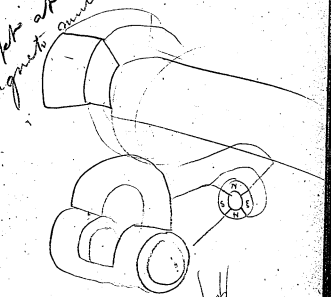
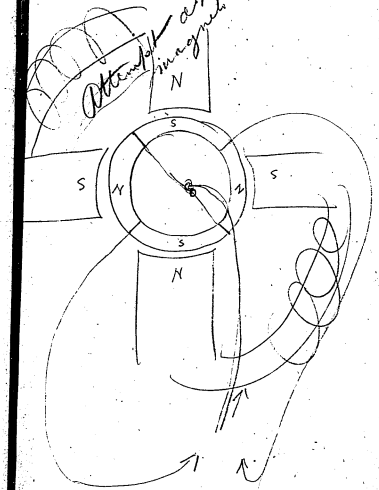
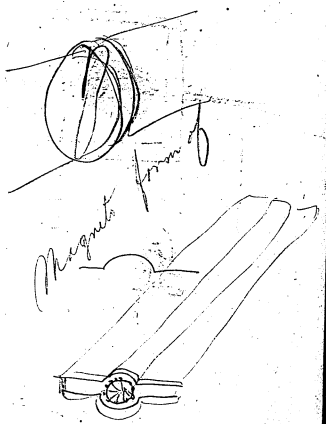


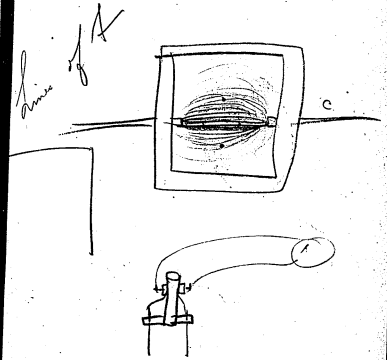
Attempt at magneto amplifier



Attempt at magnetic multiplier






C
A

6
6
36
44

144
144
1584

25
25
125
50
625
44
2500
2500
2500
2750

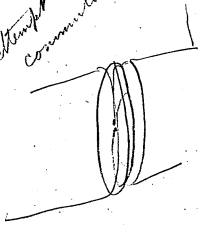
105 / 1584 (15
105
534
525
9

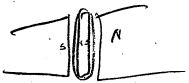
18
18 : 9
42

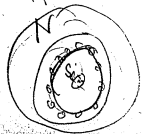
175 / 27500 (157
175
1000
875
1250
1225
25

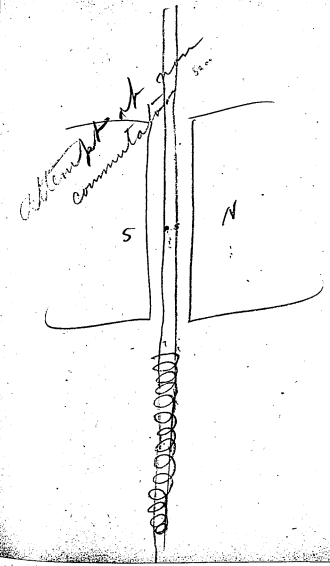
157.

Attempt at more communication



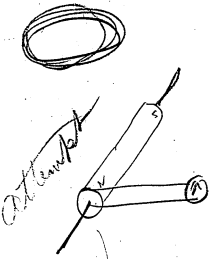


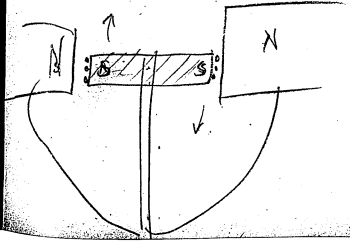


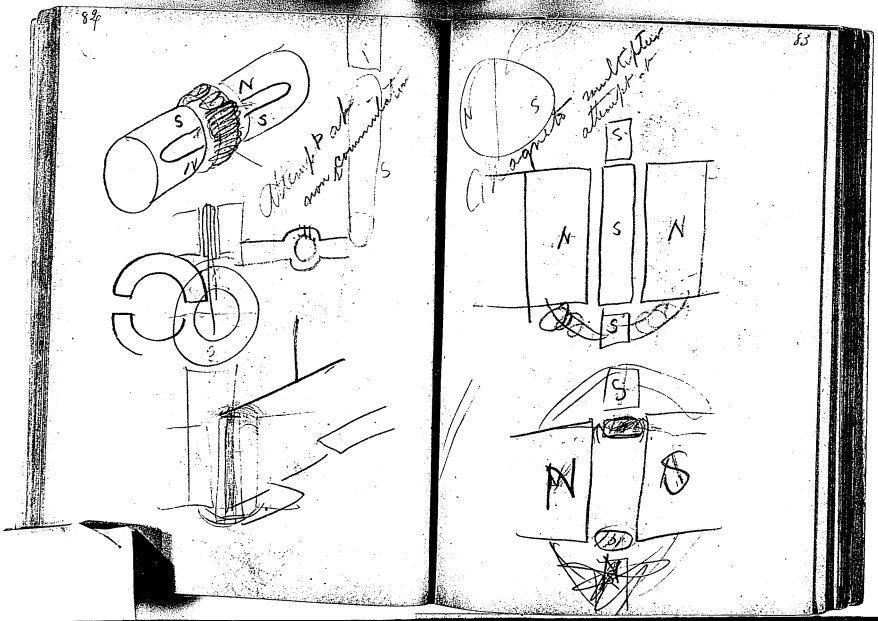

S
N

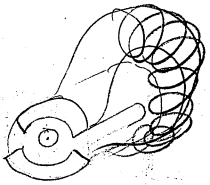
80

81

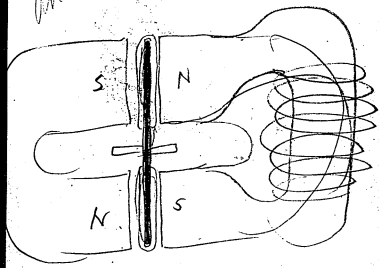


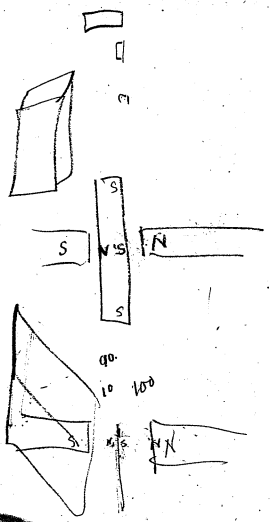



84
N
S
S
N
S
N
S
N
S
N
S
S
N
S
53

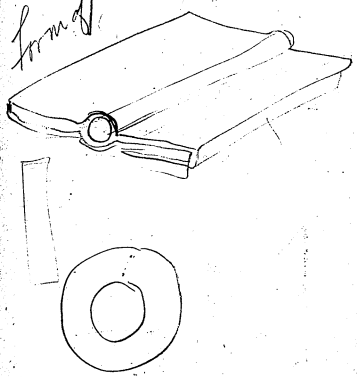


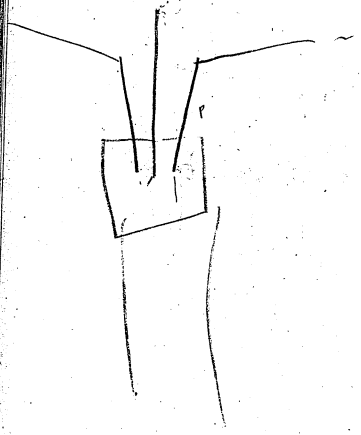
Attempt at magneto

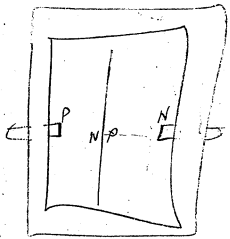




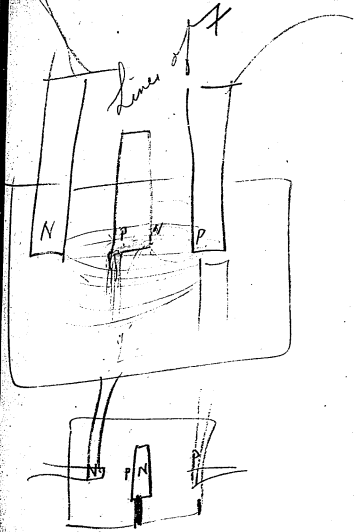
Form of magnets



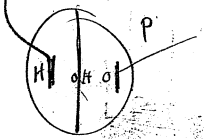

P


P
N
P
N

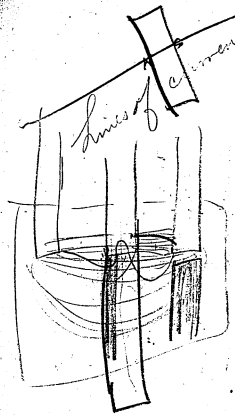
48°

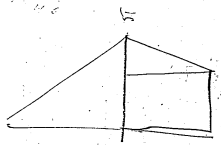


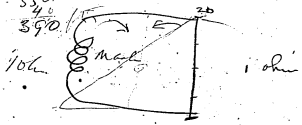
Electrolysis diagram



Lines of current



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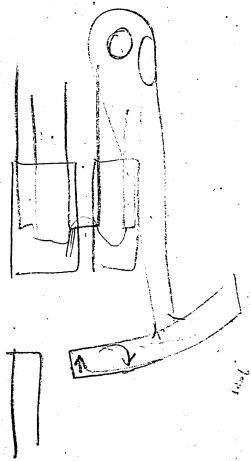


93 × 3 = 279

93 + 93 = 279

5) 845

837

8 − 5 = 3

5649

44

34596

24596

3805,56

3800

2056

1800

256

2250

450

Transaction

Dr

Cr

s

25

H.O

n

t

400) 380556 (951

3600

2055

2000

556

400

375) 380556 (1015

375

555

375

1806

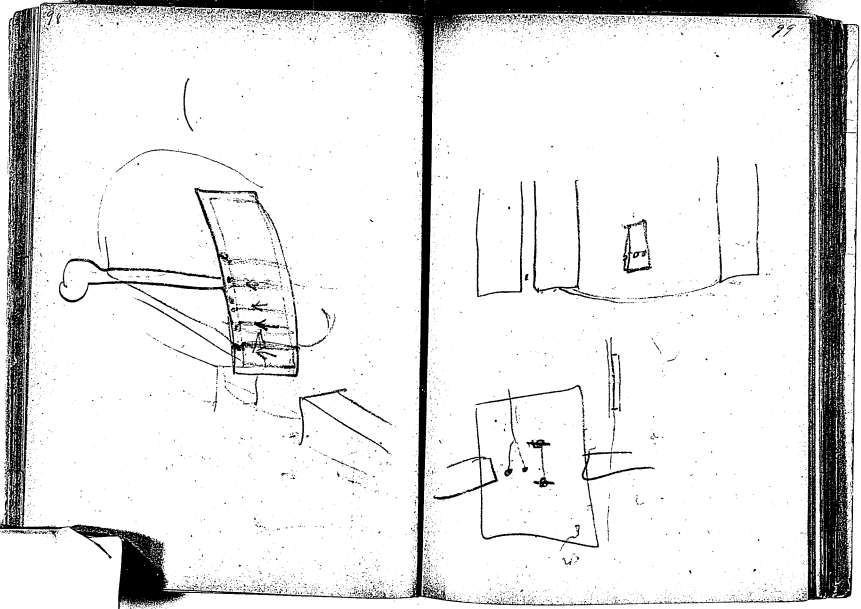
16.

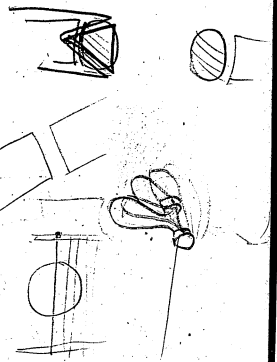
25) 951 (38

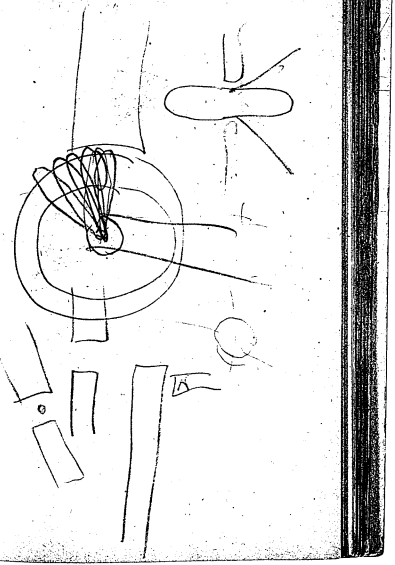
75

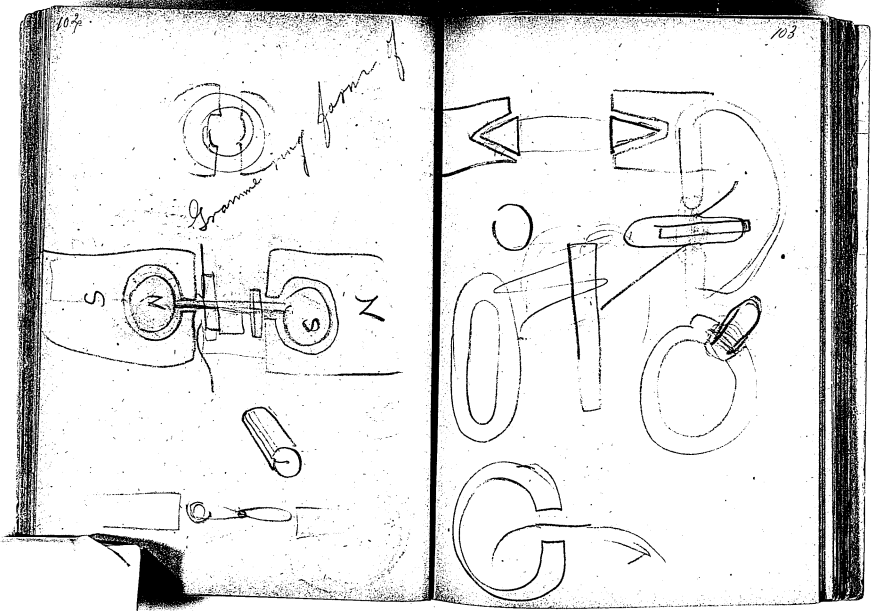
201

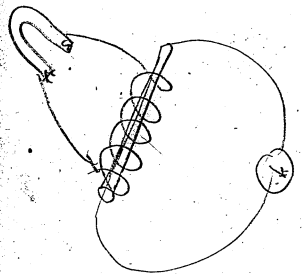
200

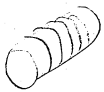


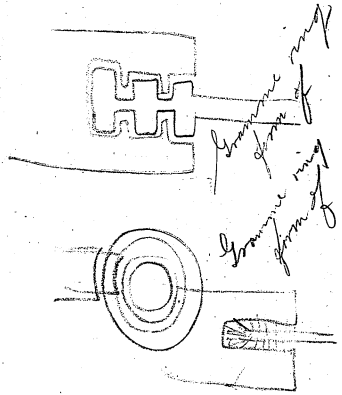


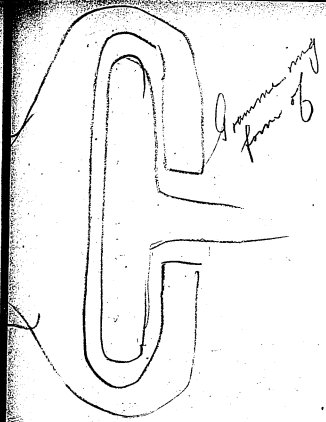


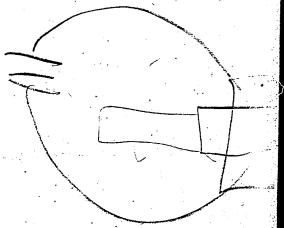

102
103



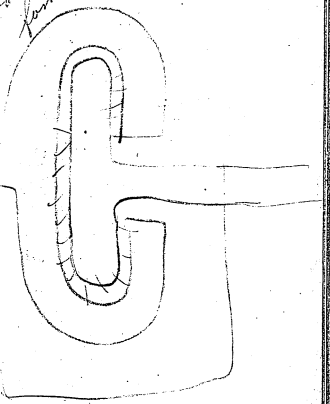



Grommet ring
Grommet ring


Grommet ring



Gyroma ring
form of



Dynamometer

Make iron spiral of
$\frac{1}{4} \times \frac{1}{8}$ iron. Inside
hole $\frac{1}{2}$ and about 6 inches

long. Wind wire on small
bobbin & pass through &
wind it round lengthwise

32
32
64
96
1024

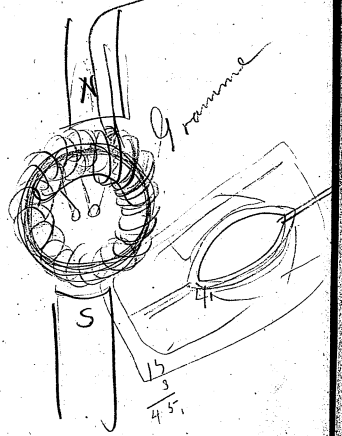
2.95
2.95
1475
2655
590
8701.25

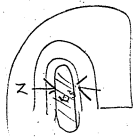
1024 : 900 :: 99.11
900
1024) 99110 (96.8
9216
7030
6144
8860

96.8 feet per Ohm

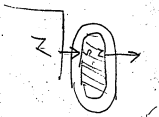
3.5 feet around
2 ohms 3.5) 193.6 (55.3
175
186
175
110

18) 553 (30
54
13

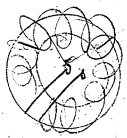


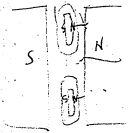


10
1
15.
6
90.
160.



8.
15 1
10
100 300
2 foot.
20
6 24
120.




S
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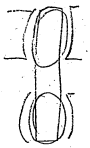

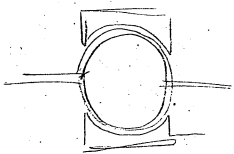

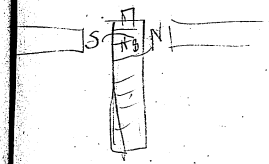
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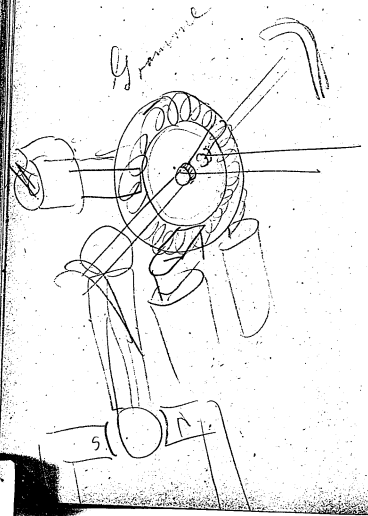
S
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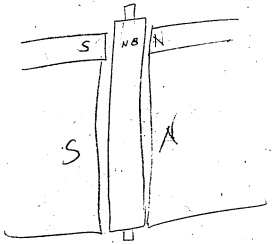
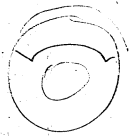
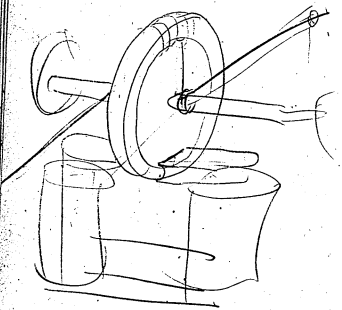
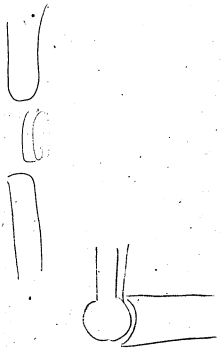
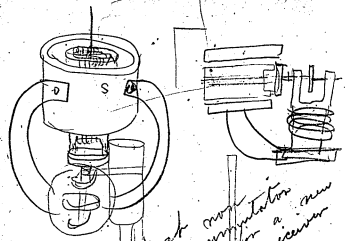

S
NB
N
S
N

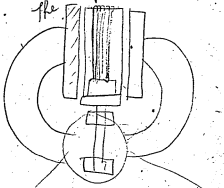




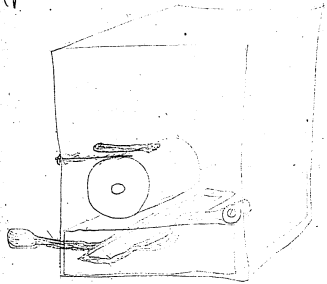




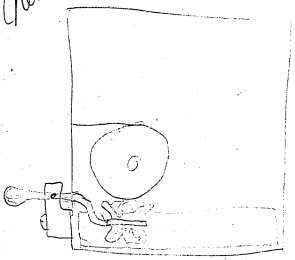
Attempts at compensation for a new telephone receiver

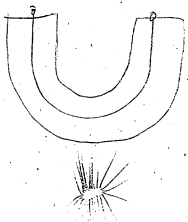


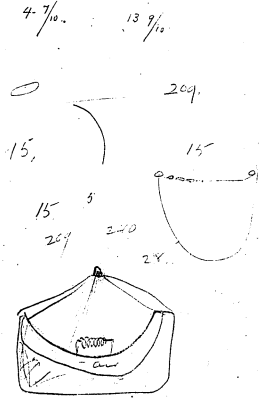
New microphone receiver

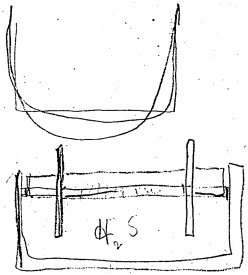


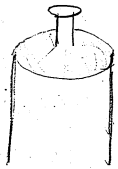
New receiver



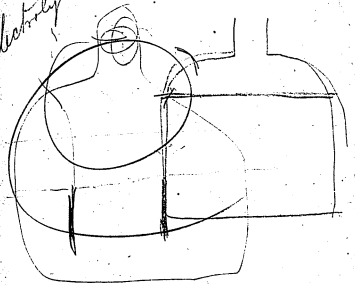

16.
5.
1.
3.

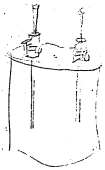

4 7/10.
13 9/10
20.
15.
15
15
5
20
2 1/2 0
28.
30.
150.





Electrolyseur





No. 1 clipped corner
39.150

No. 2 43.200

11-10

5 cells short circuit through the cell plates 1½ in apart

11-37

No. 1 40,950
39,150
1,800

43200
41.200
2000

27 minutes

.00326 × 60 × 27 = .7228

$\bar{3}$.5132
$\bar{1}$.7782
1.4214

5.27 Grammes

1,800 / 5.27 = .2553 = 1/3

10 Volts = EMF

30 Ohms in circuit if!

Fig. 14. furnace

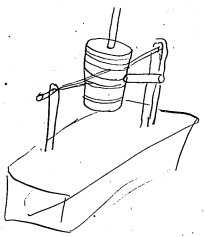
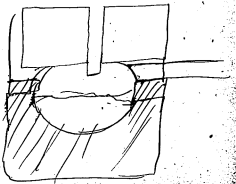
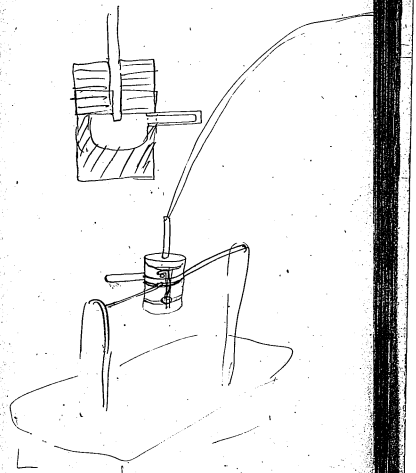
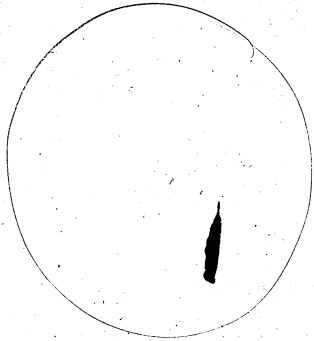


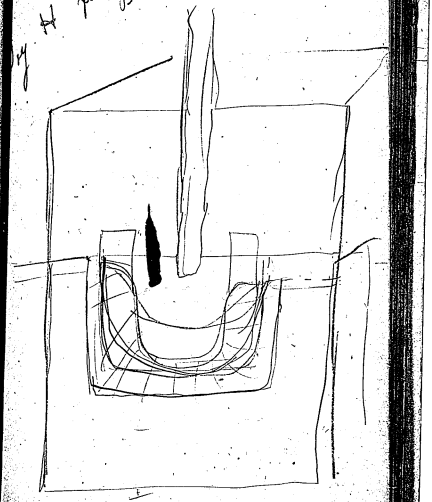
Fig. 15. furnace

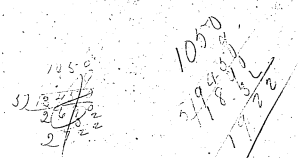


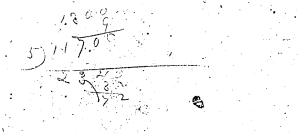


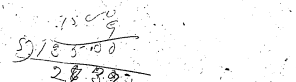


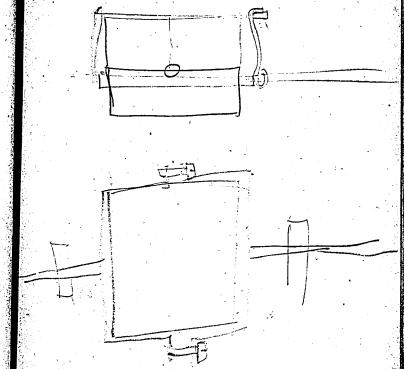
My H furnace -
B-











152

Downstairs

36·2

255.

157.

157
36
193.

85
3
255

85
85
425
850
7225
44
289000
289000
3179
193
1249
1158
910
772
1380
1351
49.

193 / 1647

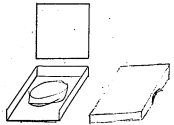
193 / 1647 (
286
1359

193
8
1544.

36
4
288

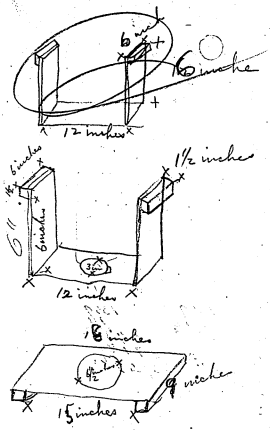
153

1250
16
7500
1250
20000.

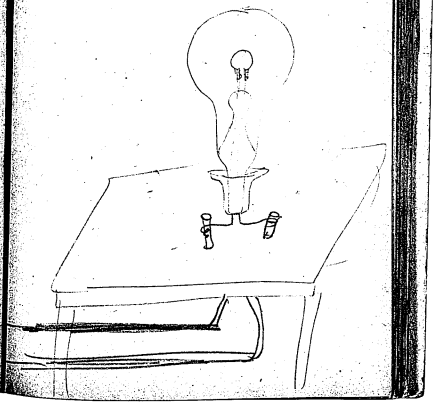


1359
2718

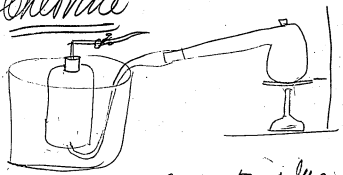
1359
24
5436
2718
32616.



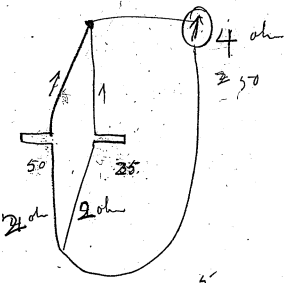
Make a steel wire spiral and dip in Lime solution



Chlorine

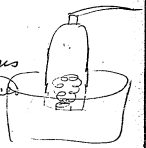


500 grains Black Oxide Man-
4 ℥ (measured) of HCl
gentle Heat
about 5 pints of Chlorine



Nitrogen

Jar of water
Fix piece phosphorous
on porcelain cover fixed
to cork
cover with Bell jar
and the [illegible] combines with O and
leaves N free in jar



160

250

9 250

3/4 = .75

3.14
.75
1570
2198
2355

2.35
235
188
1880
1410
235
941.80

441) 33000 (76.
3087
2130

161

Wt of tail

5 lbs 10 oz

8.4 Ohms

+ 4 lbs +4 = 12 & 10 oz

8.7 9.3 Ohms

16 lbs 10 oz

10.5 Ohms

Wt

5 10

+9 4 5-1/2 oz

9, 15 1/2

9.7

34. 6 6

34 lbs 6 oz

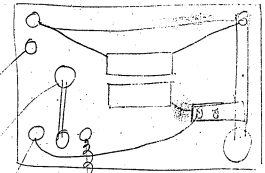
9 1 0

43 lbs 7

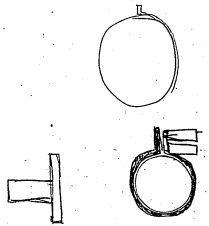
9.9 Ohms

16.7 Ohms

17.2



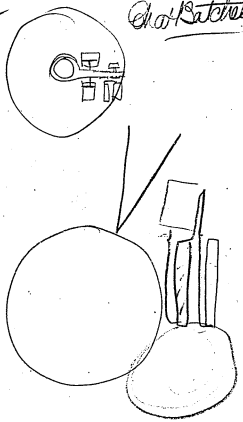
4 long wires

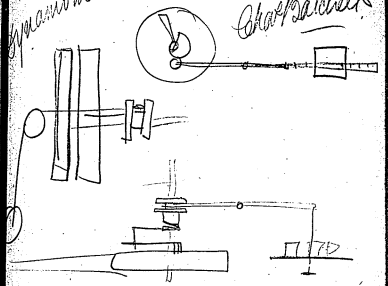


Dynamometer

March 20 1919 165

Chas Batchelor





log 166 — 2.2201

	#		
$\bar{2}$.	2417	.174	0.8896	7.75
$\bar{1}$.	7193	.524	1.1146	13.0
1.	9313	.853	1.3243	21.1
1.	05173	11.20	1.9257	84.3
$\bar{1}$.	52854	.337	1.1584	14.4
$\bar{1}$.	71941	.524	1.2705	18.6
0.	08635	1.30	1.8935	76.5
$\bar{2}$.	33141	.0214	0.5812	3.81
$\bar{1}$.	66711	.464	1.3580	24.4
0.	17810	1.51	1.6790	48.9
2.	44960	31.30	2.9721	830.5

~~8.33~~
~~8.32~~ 1.9206
2.2201
1.9206

log 83.3 — 1.9206

$\bar{2}$.	94221	.0875	0.5901	3.89
$\bar{1}$.	41981	.262	0.8151	~~8.52~~
$\bar{1}$.	63181	.428	1.0248	
0.	75781	5.65	1.6262	10.5
$\bar{1}$.	22901	.769	0.1589	7.23
$\bar{1}$.	41991	.263	0.9710	9.33
0.	36401	3.66	1.5840	~~38.3~~
$\bar{2}$.	03191	.0108	.2917	1.96
$\bar{1}$.	36761	.233	1.0885	12.2
$\bar{1}$.	88151	.761	1.3895	24.5
2.	19651	15.7	2.6226	41.9

log 3333 — 1.5228

2.2201
1.5228

	#		
$\bar{2}$.	65441	.0452	.6873	
$\bar{1}$.	03201	.108	0.2023	1.59
$\bar{1}$.	24401	.175	0.5273	3.36
0.	36401	.2231	0.6370	4.33
$\bar{2}$.	84121	.0694	1.2384	17.7
$\bar{1}$.	03221	.108	0.4711	2.95
0.	17621	1.51	.5832	3.83
$\bar{3}$.	65441	.0044	1.1962	15.7
$\bar{2}$.	97981	.0954	1.8939	~~78.3~~
$\bar{1}$.	49371	.311	0.7007	5.003
$\bar{1}$.	80871	6.44	1.0017	10.
			.2348	171.

Wt of Pt crucible

~~15.7245~~

15.865
15.7245
.1405

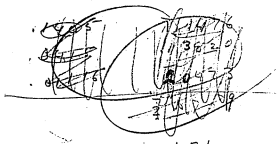
Comp .1405 10.8524 - 10
.0415 $\bar{2}$.6180
.01116 $\bar{2}$.0473
3.5177

E.B. ~~.00326~~
log .00329 .0415 $\bar{2}$.6180
.00329 $\bar{3}$.5177
log 12.6 1.1003
comp 27 8.5686 - 10
comp 60 8.2218 - 10
3.8907
.00777 2.1093
128.

Wt of Cu Plate

~~10.4695~~
10 4695
10.5711
10 4695
.0416

.01116



Comp .0415 - 10
.01116
.00326
.00329
.00327

~~.0477~~

12

Tell Daniell

Time

9 – 40

Time 10 – 07

27 Minutes

Gramme degree C

1 Gramme = .002204 lb.

424 Gramme metre

2.2808 10^3

Log 10 3		3.
log	3.2808	0.5159
log	.002204	$\bar{3}$.3434
	60	1.7782
		2.6375

.00336 Zn

log	.00336.	$\bar{3}$.5263
log	60.	1.7782
log	714.	2.8537
log	.002204.	$\bar{3}$.3434
	424	2.6274
	2.2808	0.5159
		2.6449

44 0

10^{10}

10^7

10^3

$C = \frac{\varepsilon}{n}$ $\quad \varepsilon^2 = C^2 R$

$W = C^2 R \quad \varepsilon = C R$

$W = \frac{\varepsilon^2}{R} = \varepsilon C$

$W = C^2 R = \frac{\varepsilon^2}{R} = \varepsilon C$

$\bar{3}.85993$

log 10^3

log .5159

colog .00204

Metric grammar

Comp 9.81 $\frac{6375}{9.99983}$ $\frac{}{.85958}$ -10

44.2

290 / 55 / 330

$\frac{18}{290}$ 20

$\frac{1}{3}\frac{9}{330}$ 20 $\frac{29)26}{29}$ 70 (1.

$33)\overline{38}$ (1.1

33

50

33

170

$g = \frac{E}{R+q}$

$q = \frac{1}{2}\frac{E}{R+\frac{1}{2}q} - C$

$R + q = 2R + q - 2C$

$R = 2C$

75

450 A.P. =

$\frac{1}{453 \text{ A.P.}} = \frac{18}{20}$

$1 = 290\frac{1}{4}$

Resistance 3 cells
Called through small
plates in bridge 3 Ohms

No. 1 Clipped carrier
10.0445
10.094
.0505

No. 2 10.3673
10.314
.0533

Resistance battery
37° 30'
1.9 Ohm

June 10–43
1 Daniells through 4.9 ohms

11–36

11–53
36
17

No. 1 10.394
10.317
.077

No. 2 10.388
314
.074

4.9

$\frac{1}{4.9}$ Weber 9,80,98...10

.204 Webers

.075 Grammes

17.) .075

.0120

.00441

.204

.0216

60.

.000361

$\bar{2}.8751$

$8.7696-10$

$\bar{3}.6447$

$-.3098$

$\bar{1}.3349$

2.7782

$\overline{4}.5567$

3.09

2 coils

3.54

304

48

4 minutes

$\frac{2}{6.8}$

No. 1 9.816

No. 2 10.575

2n	65.510	Heat Units
	39.415	" "
	10.017	10.575
	9.816	10.388
	.201	187

.194

2/6.8 Webers

1/3.4 T.4685

.294

.194 T.2878
.294 T.4685
Comp 60. 8.2218 —10
4.9781

Comp 45

.194 T.2878
comp by .294 D.5215 —10
Comp 60. 8.2218
Comp 45. 83468 —10
4.3879

.00244

9 mi. deg. C.

733

.003411 10^4

4156

9.81

424 2.6274
9.81 0.9917
3.6191

4160. Metre grammes
Kilo Metre

10 1^4

Centimetre 100000
1 to
1000 M

9.81 through a metre

4160 ~~kilo Metres~~

K M S

4160 (C G S)

10^4 10^4

10^4 C G S.

10^4 C G

4.4 Kilo Metres

1 Kilo H_2O 1°C

E = What work done in ergs by unit of current in unit of time.

4156.	3,6186	Joules equiv.
10^4	4.	reducing Metre & Gm
734.	2.8657	Zn equiv.
	10.4843	
.003411	3.5330	Water equiv.
	8.0173	
	1.041 10^8	Daniells

Page 129

Dec 45 minutes 2 Daniells cells working on three Ohms outside, inside about 1.9 each Total 6.8 Ohms, deposited .194 grammes of Cu.

Comp log 2.2	0.6576	
Log 6.8	9.8328	-10
log .194	$\bar{1}$.2878	
comp log 45	8.3468	-10
comp log 60	8.2218	-10
	26.3465	
	$\bar{4}$.3465	

.000222

log 3.4 .5315-

11, 2 cl

1 cell Daniells

Now the combustion of [illegible] .00341 Gm gives out how many foot lbs of energy

1 Gramme burned in battery gives off 714 Gm deg C

425 Meta Gramme Grammes .0022 lbs

Metre = 3.28 Foot

Log .00341	$\bar{3}$.5320
Gm deg C 714.	2.8537
Joules Equiv 425.	2.6284.
Feet in M 3.28	0.5159
lbs in Foot .0022	$\bar{3}$.3424
Sec in min 60.	1.7782
	2-6506

T 447.

Strawbridge gives the following statement

509,418 Metric Grammes per second

Current .86 Webers

R .675 Ohms

Log	509.418	5.7072
Log	3.28	0.5159
Log	.0022	$\bar{3}$.3424
comp log	86	8.0615 −10
comp log	86	8.0615 − 10
comp log	.675	10.1707 − 10
		29.8592
	.723	1.8592
log	60	1.7782
		1.6374
	43.3	foot lbs per Weber in Ohm

Numerical

Work	10^3	$= \frac{(10^5)^2}{10^7}$
	10^3	10^3
Log	9.81	9.0083 − 10
comp log	60	1.7782
Log	3.28	0.5159
Log	.002204	$\bar{3}$.3432
Log	44.2	1.6436

1 Weber equiv. Jn .003411

Log	.003411	$\bar{3}$.5330
Foot Pdlbs	714.	2.8537
Joule	425.	2.6288
Ft in Metre	3.28	0.5159
Lb in Gramme	.0022	$\bar{3}$.3424
Sec in minute	60	1.7782
	448.	2.6520

1.0411 108 Daniells

log 10^8
comp log 9.81
comp. log 1.041
comp. log

$f = \frac{L m}{T^2}$ $\frac{L^2 m}{}$

1.4840
1.4840
2.9680
2.8115
1.7795

951

1.2580
1.4057
2.6637

E. g. $\frac{(10^8)^2}{169} = 10^7$

119

$\frac{m}{m}$ =

772 4.2354.

$\frac{m}{2 \overline{)2.8115}}$ $\frac{1.4840}{1.7420}$ L

1.4057 3

7420 2.2260

0.1477 1.4057

$L T^2 m$ $\sqrt{1.5317}$

$L^2 T^{-3} m$

9.81 D 9917
425. 2 6284
1000 3

~~6.6220~~
~~6.6220~~
~~.6201~~
~~4900000~~

~~41.700000~~

0.9917
2.6284
1000 3
6.6201

981

9.81
425.
1000

Dyne 1/981
Dyne 1/981

1 Deg C. Gramme. H_2O
425 Metre Grammes
42500 Centimetre Grammes
981 Erg no C.G.S. in one Gramme Cent.

4.6284
2.9917
7.6201 41,700,000
Erg per gram degree.

192

Ohm 10^9

Farad 10^{-1}

10^{-1} C. G. S.

$(10^{-1})^2 (10)^9 = 10^7$

10,000,000 Ergs

3

41.560,000 Erg 1m deg C

41,560.000 000 Erg Kilo deg C

9

2

18

180,000,000

60 minute

10,200,000,000

41.560 000 000

193

$L^2 f^{-3} m$

$L^3 f^{-4} m$

$L^2 f^{-3} m$

log 41,572,500	7.6185	
comp log .981	7.0083	-10
comp log 100	8.	-10
423.	2.6268	

772.

423

.009421 Mllgr.

.000009421 Grammes

1. Mg = .001 Gramme

.1 = .0001

1

.09771 H_2O Ruff

.0116 Mllgr Wid Vol 1111059
1 Daniells through Siemens
Complg .973 unit

Siemens = .973 X
Ohm = 1.0196 X

Siemens = .973 / 1.0196 Ohms

log .9954 $\bar{2}$.0645 T.9881 .0083 $\bar{1}$.9798

log .0116 / 1.0196 $\bar{1}$.9798

.973 / $\bar{2}$.0443 -10

1 / .0110

Mllgr Hydrogen evolved from H_2O in one second by a Daniells through one Ohm

.000121 Grammes

.377 Mllg of Cu deposited in one second by a cell of Daniells through one Siemens
Result Wid. 1060

log .377 T.5763
Col .954 T.9798
T.5561

.359

.000359 Grammes on 1 Ohm.
for 1 second.

.0116 / 9 / 099

.000103 Gramm.
.103 mg
.0103

00

Box 8 lbs

α = 38° 30'

6 lbs

α = 56° 30'

8 lbs 59° 8

10 lbs

Box 8 lbs

280

12 lbs. 42° 30'

16 lbs. 50° 30'

20 lbs. 54° 30'

24 lbs. 56° 30'

28 lbs. 60°

32 lbs. 61°

36 lbs 63° 30'

40 Mis fs

36 lbs

400 revolutions

36 lbs

61°

3.1415 diameter

20 / 12 | 1.6 2.83

5.24

3 Ohms

5.24
480
41920.
2096
2515.20

25.15
36.
15090
7545

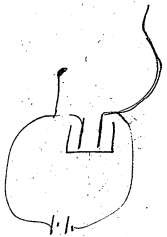
33000 | 80.540 | 66.000 | 14540 | 2.7 H.P

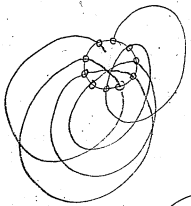
550 3 Ohms

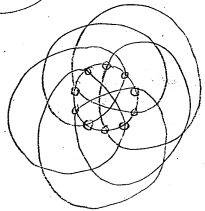
22 lbs 270
540 revolution

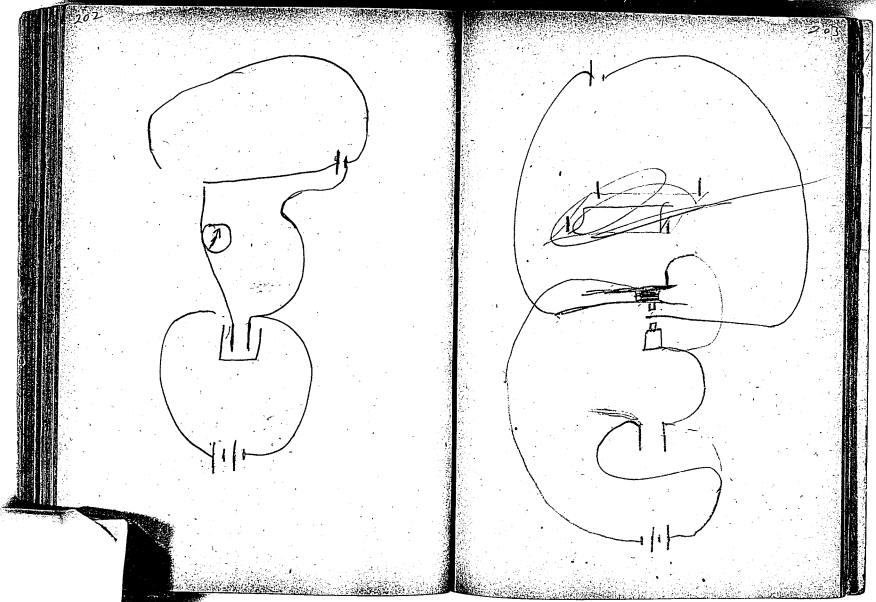
5,24
540
20960
2620
2829,60
22
56658
56.58

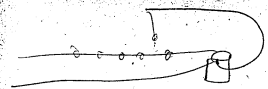
33000 | 62.238 | 33 | 292380 | 1.8 H.P

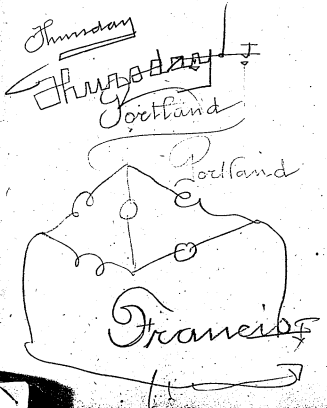












Friend French

Friend Friendship

French Friendship

French Friend

Friend Francis

Francis Francis

Frang

Frangapani

Francis

206

3000 hp	75,000.
Dinamos	48,000
Boilers	45,000
Feed H.	10,000
Piping	10,000.
Shafting	30,000.
fitting up	25,3,000.

Engineers Stokers	10,000.
attendants	5,000.
Labour	2,500
Coal	35000
Oil	3000
Repairs	3000
	5,000
	63,500.
Interest	37,1000.
	100,500

425
365
25
340
912
365
30
10,950
3
32850

10

207

75000
15000
45000
10000

365
50. daily
18250

1 — 16 per year

18

6000 / 100000

15/6 = 90; 16/6 = 96

63000

3000/6

600
200
120,000

208

7 | 1756
6 | 1883
5 | 10 59
4 | 13,24
3 | 17.66
2 | 2649

10 59
5298

7/5298
7576
5292 39

9/5298
5886
78.7

8.83 Cents

3. 5/5298.
10 59 -3

8/5298
6624
44.

44. 5095

4/5298
13244
5296

1259
5
6295

3/5298
1766
3
5298

1766

2/5298
2649
2
5298

209

Station plant 300 000
" Expenses 63,000,

18000 lights

18000/63 000/3.50
54000
9000

3.50 per year
5.33
8.83.

600.000.

16
6
96

18000/00.000/5-3
90 123
6

No 1 Spiral Mch 19 1879

10.45 — 2 cells

3

10.58 — 4

11.05 — 5

11.19 — 6

11.2 — 7

8

11.35 — 9

11.48 — 10

11

11.50 — 12

13

11.52 — 14

11.56 — 15

11.54 — 16

11.55 — 17

11.56 — 18

11.57 Taken off

Vacuum 1¾

No 2 Spiral Mch 19 1879

1.20 — 2 cells 3/4

3

1.28 — 4

1.37 — 5

1.47 — 6

7

8

9

1.53 — 10

11

2.00 — 12

13

2.01 — 14

2.14 — 15

16

2.16 — 17

18

2.18 Taken off.

Vacuum

900 90 810.00

6000

74 3552 222.00

174

18,000 50 900.000 9

2.7 81.50

9

6000 2200) 60000 (27 4400 16000 15400 600

5

13650) 18.000 (1 13650 4350

136 50

18000) 136500 (.0075 126000 105.00

1 900 10 9000

136.

900 15 4500 900 13500

Daily 10 hours

H.P.

3000. -

18000 lamps

Engineers	9.00
Stokers	7.00
assistants	18.00.
Inspectors	5.00.
Coal 27 tons.	81.50
Extra coal 3 tons	9.00.
Oil	3.00
Waste	1.00
Repairs.	10.00.
one day 10 hours	136,50.

3/4 of 1 cent for 10 hours

gas.

18000 burners consume.

900.000 feet in 10 hours

which taking the actual cost of producing the ~~light~~ gas at 90 per 1000 feet,

gas $810.00

Electric. 136.00.

or as compared with Electric Light

~~Electric light must produce~~ in economy gas must be made for 15 1/8 cents per 1000 feet =

in England the £ Light. worked 6s.

Engineer	6.00.
Stoker	4.00
Assistant	6,00
Inspector	6,00
Coal 27 Tons	54.00
Lighter Expn	6.00
Oil	2.00
Waste	1,00
Repairs	8,00.
	93 00

Three Groups cost to about 10½ Cents per 1000 feet.

No 3 Spiral Mon 19.7.9

3.01	2 cells
305	3
312	4
317	5
321	6
	7
3.13.5	8
	9
345	10
347	11
348	12
348	13
	14
	15
	16
	17
	18

No 4

2	3.50
3	
4	
5	4.05
6	
7	
8	4.12
9	
10	4.20
11	
12	
13	4 38
14	

No 5 Spiral

4	4.40
8	5.00

No 6 Spiral March 19 Electric

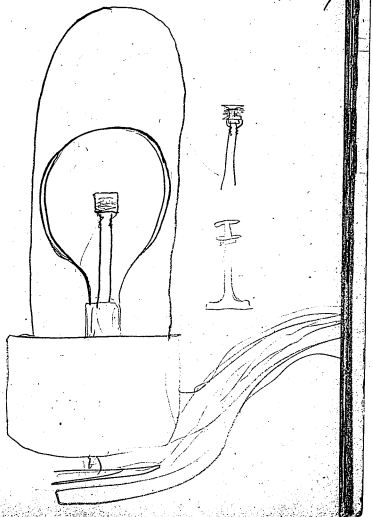
5.21 — 3 cells
5.28 — 4
5.38 — 6
5.40 — 8
5.46 — 10
5.54 — 12
5.58 — 14
5.56 — 13
5.57 taken off

No 1 Spiral March 20 19

11.15 — 2 cells
11.30 — 4
11.40 — 6
11.50 — 8
11.53 — 10
11.56 — 12
12 — 14
12.10 — 16
12.15 — 17
12.18 taken off

Treasury 19

March 19, 1879



220

1 1/2 in

15 | 36 3
15

15
3
45 feet

1 1/2

221

Gramme Machine on
9 ½ ohms and Spiral at
Yellow Led 2.20

Dynamometers

Box

2	10 oz
2	1 0
2	8 oz
	17
7 lbs	14 oz

1 lbs to balance fruit

2 lbs	9° 30'
4 lbs	15° 30'
6	19° 30
8	26°
10	28° 30'
12	29°
14	31°
16	33°
18	35°
20	37°
22	37° 80'

D = -1

24 — 40°

26 — 41° 45'

28 — 43° 30'

30 lbs — 44°

32 lbs — 47°

38 lbs — 50°

42 lbs

20.

300.

576 / 317 900 (567
288 81
29 90
28 80
1 1 00
1 1 52
562

562

540 / 55 / 2700 / 2700 / 2970 0

540 / 54 / 4860 / 2700 / 2160 0

540 / 62 / 1080 / 3240 / 3348 0

61.

34 lbs

520

3,14
20
12 / 62.80
5.23 feet

5.23
520
10460
2615
2719.60 feet

34
10876
8157
92446

33000 / 92446 (2
66000

2

33000) 92217 (2
$\not{9}\not{8}$000
26.217

5' - 23

34
5
170
7,82
177.82

34
23
102
68
7.82

177 . 82
520
177
354
885
92217

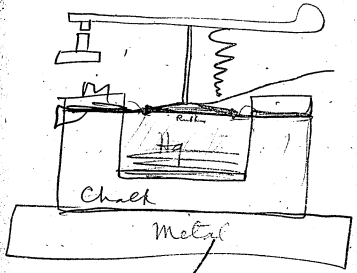
April 8th 1879

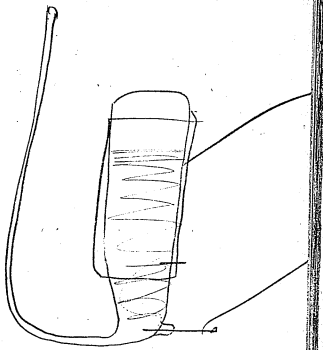
Put on 10-55 a.m. off 12 m. started 1 P.M. off 6 P.M., started 7 P.M. off 10 P.M. 9 hours

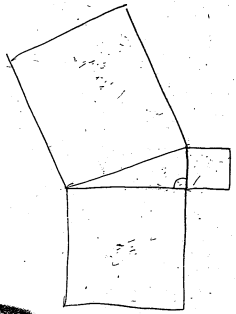
April 9

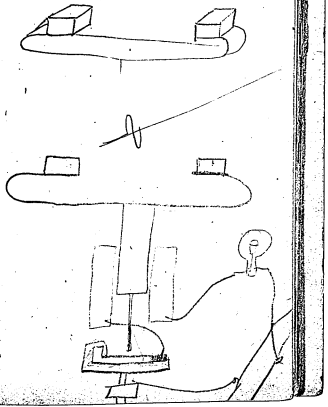
On at 7 a.m. 1/2 of the top layer crossed at 11 a.m. took it off to fix at 11-36 A.M. — The glass was very black, but we found it was due mostly to the hard rubber insulation on the rod which had burned to a crisp. We separated the spirals and put it on 11 a 58

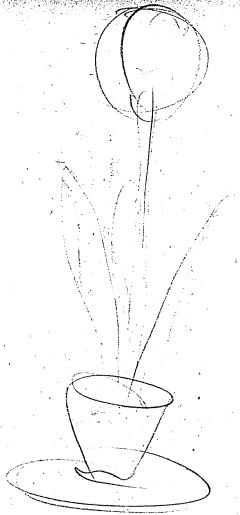
Apr 9
Taken off 12 M
Put on 1 P.M

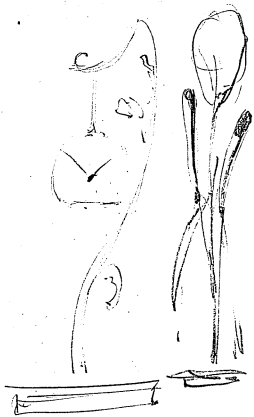


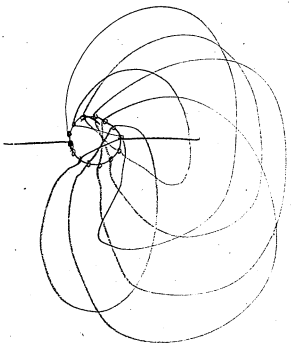


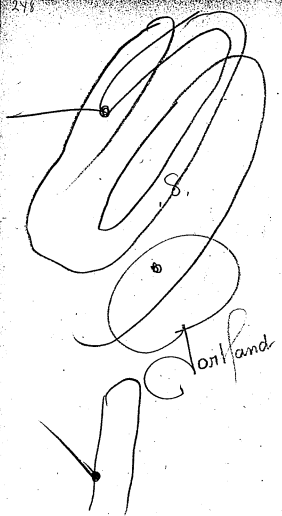


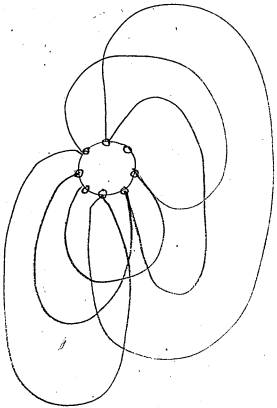


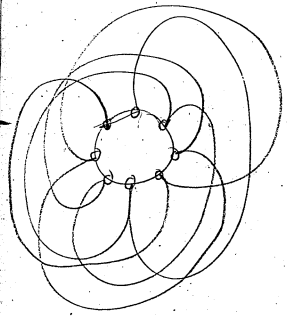


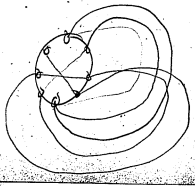


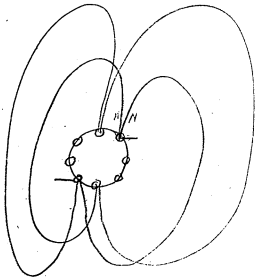


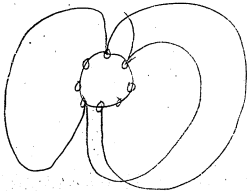

S.
Torr Sand











252

6X6 = 36

144 | 4

104 [illegible] thumb

120 thumb

10 · 1020 thumb

10 · 10 thumb

10 degree

16.

253

2·15 Inches by 2·15 X 18

18

2120

215

4170

215

4170

15 05

215

8600

8965

2·15 X 41·70 = 8965

41·70 + 2·15 = 43·85

4385 | 89·65 | 2·0

8770

1895

...

274° to the right
240° " " "
46° " " "

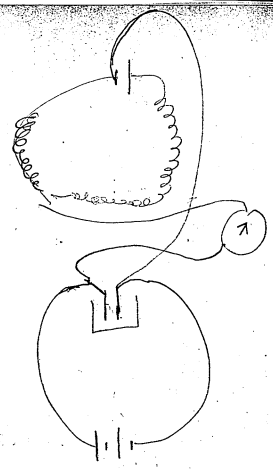
65° to the left
75° to the right
19° to the right
19° to the left
76° to the left
76° to the right
220° to the right
210° to the left
220° to the right
0°

187° to the right
181° to the left
180° to the left
178° to the left
65° to the left
59° to the right
55° to the left
53° to the right
175° to the right
125° to the right
190° to the right

195° to the right
195° to the left
205° to the right
198° to the left
198° to the left
200° to the left

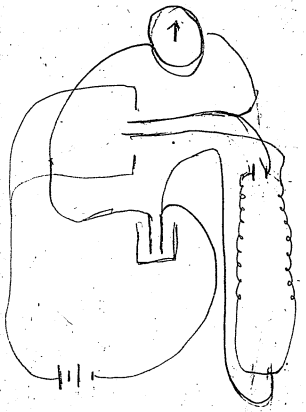
1

85 100 3179.
85
425
680
7225
44
1
2890 0
2890 0
179.80
200 | 3179
1589 —
16,
1

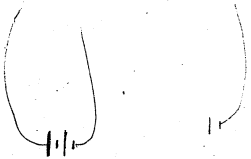


205° to the left
213° to the right
205° to the left
175° to the left
178° to the right
203° to the right
175° to the right
55° to the right
55° to the left
0°
5° to the left
195° to the left
200° to the right
204° to the left
196° to the left
198° to the left
205° to the right
210° to the right
170° to the right
208° to the right
205° to the right
0°
90° to the left
20° to the right
63° to the right
65° to the right

70° to the right
48° to the right
50° to the left
25° to the left
207 to the right
198 to the left
207 to the right
175 to the right
155 to the left
5° to the left
50 to the right
0°
0°
48 to the left
45 to the left
45 to the right
175 to the right
215 to the left
205 to the left
55 to the right
60 to the right
105 to the right



105° to the left
210° to the right
215 to the left
210 to the left
208 to the left
0°
205° left
210° left



315 left
310 left
305
0°
305 right
149 left
220 left
225 left
220 right

70 right
70 " "
210 " "
215° " "
221°
225° " "
230° "

17 left

204 right
99 right
100 right
204 right

170 right
84 " "
85 " "
20
169° left
82 " "
85 " "
84 " "
80 " "
81
85 " "
83 " "
20

95 right
79 right
95 right
15° right
40 right
69 right
20
85 right
40 right
86 right
45 right
20
40 right
83 right
40 right
75 right
83 right
44 right
20 right
83 right
20

96° right
205° right
20

97 right
0°
96 left

98 right
95 right

90 R.
85 L.

124 left
127 right
125 left
122 left
125 right
45 right
90 right
0°
235 right
117 right
115 right

117 R

114 R.
114 L.
114 R
230 R.
228 L
114 R
115 L
124 right

124 R
124 L
228 R.
360 R
124 R.
360 R
124 R
240 R
228 R
228 L
115 left
115 R
114 R

125 R
115 R
125 R
128 R
125 L
126 L
124 L
43 R
43 R
44 R
50 R
55 R
44 R
44 L
90 R
44 R
89 R
120 R
125 R
120 R
44 L
89 L

129 R.
129 R.
129 R.

135 R
131 L.
124 R

1 Carbon 2 Volts .1 Ohm inter.

1 Therm $\frac{1}{75}$ Volt

1 Therm $\frac{1}{50}$ Ohm

Magnet .1 Ohm

$\frac{2}{.2} = 10.$ Webers

10 Strength of magnet

$$\frac{\frac{1}{75}}{\frac{1}{50}+\frac{1}{10}} = \frac{\frac{1}{75}}{\frac{6}{50}} = \frac{50}{75 \times 6} = \frac{2}{3 \times 6} = \frac{1}{9}$$

$\frac{1}{9}$ Weber

90 Therms to equal carbon

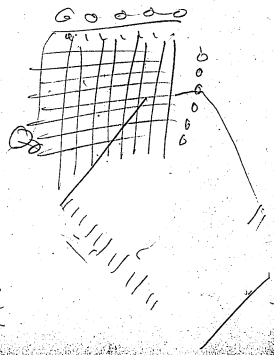
111 R
111 R
49 R
60 R
75 R
111 R
109 R
221 R
105 R
153 R
107 R
169 R
199 R
200 R
199 R
194 R
196 R
195 R
194 R
199 R
194 R

120 R
225 R Grade
232 R
225 R
45 R
220 R
214 R
215 R
220 R
212 R
220 R
217 R
216 R
210 R
120 R.

100 L
95 R
96 L
305 L
0°
85 R
85 L
100 R
102 R
0°
85° L
5 R
0°
192 L
102 R
0°
84 L
305 L
70 S
218 R
210 L
66 L
70 S
210 L
70 S
518
300 S
295 R
70 L

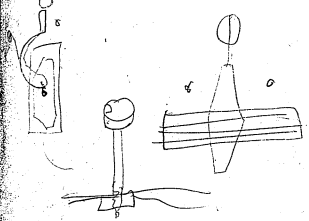
200 L
214 L
185 L
0°
49°

=



1/60 Sulphide Cu, marked 1

1/75 Double sulphide Cu and lead



$\frac{1}{50}$ Daniells

.01 = $\frac{1}{100}$ Ohm resistance

How many to give the current of 1 Daniells on .1 Ohm

Daniells $\frac{1}{2.1}$ ℔

Five in series will give $\frac{1}{10}$ Daniells E.M.F also $\frac{1}{10}$ Ohm

$$\frac{\frac{1}{10}}{\frac{2}{10}} = \frac{1}{2} \text{ Weber}$$

4

Magnet 2 Ohms
Daniell 2 Ohms

$\frac{1}{4}$ Weber

Thermo Pile

200 Thermos 2 Ohms
4 Volts

100 Thermos 1 Ohm

4 Ohms

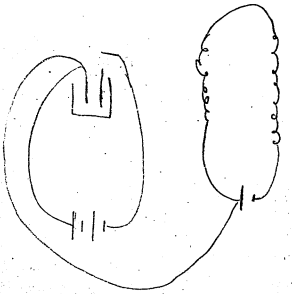
4 1/4

250 R
255 R
220 R
210 R
215 R
230 R
100 R
114 R
210 R
124 R
120 R
235 R
230 R
215 R
200 R
154 R
155
225 R
250 R
250 R

1 - 1 = 0
2 - 1 = 1

1.
/1.
///.
//1/.
////1

0.
1.
2.
3.
4.



274

255
36
219

36 | 21911 | 43.91
44
876
876
36 | 9636 | 267
72
243
216
276

267 Ohms

73
73
219
511
5329
8144
21316
213 16
234476

267 | 234476 | 878
2136
2087
1869
218

275

878 | 33000 | 36 per H.P.
2634
6660

60 | 1951 | 99
48
60 | 7550
292

267 Ohms
292 Ohms
267
25

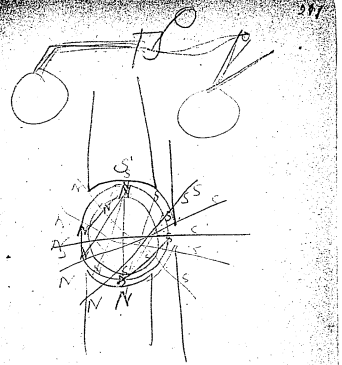
257
25
242
25
217

3 | 255
85 Volts

97
97
679
873
9409
44
37636
37636
413996
217
1969
1959

97

85
85
425
680
7225
990
72 | 940 | 15
72
220
215
4



7

6

50

1900) 33000 (1310

85
85
425
680
7225
44
25900
25900
3879
242
1759
726
330

12 : 19 :: 10 :

13) 90 (14.6 candles
13
60
52
80

16 | 1000 | 62
96
40

.15

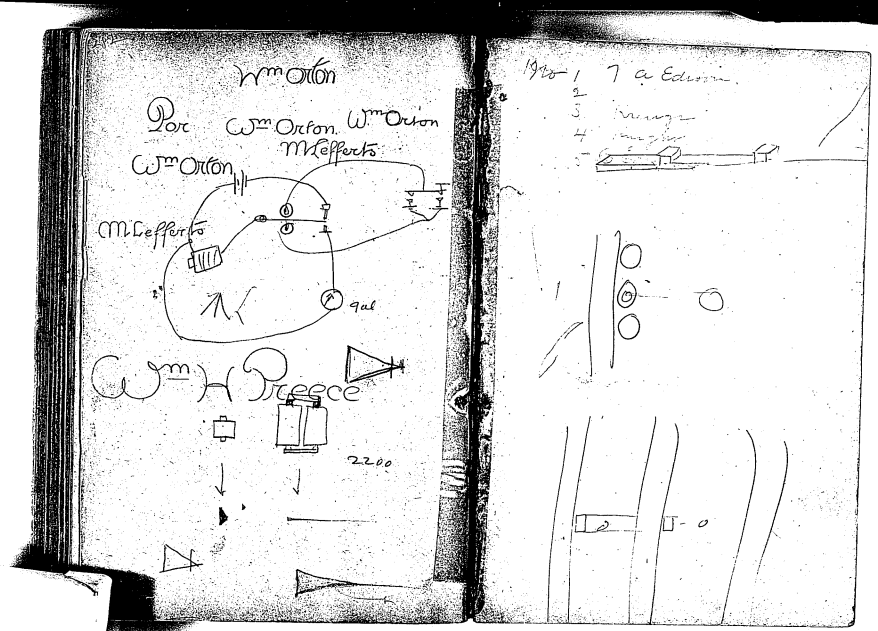
.062 = 1/16

004
.016

62
62
124
372
3844 | 240
32
64
64
0

240

240 | 412 | 1.7
240
1720
1680


Wm Orton
Wm Orton
Wm Orton
Wm Orton
M Lefferts
Wm Orton
M Lefferts
9 gal
Wm Preece
2200